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Discussions held during the twenty-first session of the Commission on Science and Technology for Development on the theme of the 2018 session of the Economic and Social Council, "From global to local: supporting sustainable and resilient societies in urban and rural communities"

Note by the Secretary-General

The Economic and Social Council has selected "From global to local: supporting sustainable and resilient societies in urban and rural communities" as the theme of its 2018 session.

The present note serves as a contribution from the Commission on Science and Technology for Development on that theme. It provides a summary by the Chair of the discussions held during the twenty-first session of the Commission, held in Geneva from 14 to 18 May 2018.

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Summary by the Chair of the discussions held during the twenty-first session of the Commission on Science and Technology for Development on the theme of the 2018 session of the Economic and Social Council, "From global to local: supporting sustainable and resilient societies in urban and rural communities"

1. The Commission on Science and Technology for Development held its twenty-first session in Geneva from 14 to 18 May 2018. On 15 and 16 May, the Commission considered two priority themes: "Building digital competencies to benefit from existing and emerging technologies with a special focus on gender and youth dimensions" and "The role of science, technology and innovation in increasing substantially the share of renewable energy by 2030". On 14 May, the Commission convened two high-level round tables, one each on the following themes: "The role of science, technology and innovation in supporting sustainable and resilient societies" and "Impact of rapid technological change on the achievement of the Sustainable Development Goals". The Commission decided to submit the summary of the deliberations held during its twenty-first session to the Economic and Social Council as a substantive contribution for consideration during the high-level segment of the Council, to be held in July.

2. The Commission examined critical issues related to the contribution of science, technology and innovation to/in the context of inclusive and sustainable development. Participants highlighted that recent technological advances, especially those driven by the rapid development of information and communication technologies (ICTs), offered new opportunities for economic prosperity, social inclusion and environmental sustainability, and could help to achieve the Sustainable Development Goals. At the same time, they raised concerns with respect to employment, inequality and ethics. Technological change and innovation should be directed towards inclusive and sustainable outcomes through strategic efforts by Governments in collaboration with civil society, business and academia.

The role of science, technology and innovation in supporting sustainable and resilient societies

3. Participants highlighted that science, technology and innovation, when adequately harnessed, could contribute to promoting sustainable and resilient societies. Many member States, including Austria, Bolivia (Plurinational State of), Brazil, China, Canada, the Democratic Republic of the Congo, Cuba, the Dominican Republic, Eswatini, Ethiopia, Germany, Ghana, Hungary, India, Iran (Islamic Republic of), Latvia, Lesotho, Malta, Nepal, Oman, Poland, Portugal, the Russian Federation, Saudi Arabia, Sri Lanka, Thailand, Uganda, the United Kingdom of Britain and Northern Ireland, the United States of America and Zambia, shared their experiences related to using science, technology and innovation for providing clean water and sanitation, affordable and clean energy, quality education and promoting digital literacy, promoting sustainable cities and communities, promoting sustainable consumption and production, and protecting biodiversity.

4. Participants noted the importance of building resilience to different types of disasters caused by natural hazards, which had become more frequent. They emphasized the use of information and communications technology (ICT) and spatial technologies for early warning and to map regions at risk using satellite data to determine where priority intervention was necessary. Zambia, for example, had used remote sensing technology to identify deforestation across the country and, as a response, had started a reforestation initiative for planting 1 million trees, including a programme that aimed at the value addition of indigenous trees.

5. Participants also highlighted the need to build resilience against economic shocks and downturns. They emphasized that growing global interdependence had led to more complex, cascading disasters with social, economic and political impacts. In that regard, rapid technological change offered opportunities but also posed challenges, and a better understanding of its effects on society and economies could help to build more resilient communities.

6. In that connection, participants noted that some of the hurdles in building resilient societies included the digital and skills gaps. Participants noted several initiatives to address the gaps. For example, Bolivia (Plurinational State of) had introduced an e-government programme to democratize access to public services and had progressed to making ICT access universal in private and public schools, with access to the latest-generation computers in classrooms. Cuba was implementing a national plan for social and economic development that included as a priority the development by 2030 of a sustainable information and knowledge society that was people-centred. The Dominican Republic had implemented a "digital republic" programme based on the pillars of education supported by technology, jobs and productivity, access to technology and e-government. Lesotho had introduced ICT in early childhood education curricula, as well as technical and vocational education for building resilience, providing the example of a local research centre that developed high-quality, low-cost devices. South Africa had adopted a national development plan to achieve the Goals, with science, technology and innovation at the core of its development agenda, and had stressed the importance of monitoring and evaluating progress towards achieving the Goals. South Africa also indicated that the country was developing a national portal that would collate information on the contributions made towards achieving the Goals. Zambia had introduced a policy to ensure that all schools would have computers available to students, so as to promote early exposure to ICT. It also stated that science would be introduced in the early childhood education curricula and that it had taken steps to mobilize programmes for women in science, including through a gender quota for scholarships.

7. Participants observed the need to facilitate technology transfer to increase the resilience of societies. They stressed the importance of the commercialization of scientific research, of strengthening capabilities with export-oriented trade possibilities and of cooperation through industrial relations. For example, China and South-Asian countries had collaborated on the establishment of the China-South Asia Science Technology Transfer Centre and on setting up national centres and research laboratories for technology transfer and development. The Islamic Development Bank had developed an online platform to connect investors with market opportunities for innovation, angel funds and seed money for innovators, and to foster partnerships between entrepreneurs and researchers.

8. Participants emphasized the importance of international and regional collaboration in sharing experiences and lessons learned to ensure that no one was left behind. They also highlighted that research and the development of science and technology to achieve the Goals required result-oriented global collaboration.

Impact of rapid technological change on the achievement of the Sustainable Development Goals

9. Participants recognized that rapid progress in science, technology and innovation could facilitate the transformations required to achieve the Goals. At the same time, rapid technological change was likely to outpace the ability of societies to adapt and manage its social, economic and environmental effects, posing complex challenges for public policy.

10. Participants expressed appreciation for the report of the United Nations Conference on Trade and Development (UNCTAD) entitled *Technology and Innovation Report 2018: Harnessing Frontier Technologies for Sustainable Development*. In the report, UNCTAD called for an international dialogue to develop policy responses to the serious ethical, environmental, economic and social questions raised by frontier technologies. It also identified the Commission on Science and Technology for Development as a key forum for such dialogue.

11. Participants noted that rapid technological change was driven by the cumulative nature of technology development; the accelerated rate of improvement in technologies; the convergence of technologies facilitated by the emergence of digital platforms such as the Internet; and reductions in the cost of technologies and declining entry costs for innovators. The cost reductions allowed for easy access to such technologies, thereby providing a greater number of people the opportunity to exercise their creativity and to innovate.

12. Participants noted that several technologies showed significant potential to facilitate the achievement of the Goals with applications in many areas, including industry, health care, agriculture, forestry, energy, transport and water. Big data analysis could help to address critical global issues, create scientific breakthroughs, advance human health and improve decision-making. The Internet of things allowed connected objects and machines to be monitored and managed. Artificial intelligence, in particular when combined with robotics, could transform production and business, especially in manufacturing. Three-dimensional printing allowed for faster and cheaper low-volume production and the rapid iterative prototyping of new products. Biotechnology enabled gene editing, making personalized treatments and the genetic modification of plants and animals possible, potentially revolutionizing agriculture and the management of epidemics. Nanotechnology was used in water purification, battery storage, the precise management of agrochemicals and in the delivery of medication, among other applications. Renewable energy technologies provided electricity in rural areas far away from grid systems. Self-driving cars could transform the movement of people and the use of space in cities. Drones could revolutionize the delivery of supplies, facilitate and promote the sustainable use, protection and restoration of the terrestrial ecosystem and serve to replace humans in dangerous tasks. Small-scale satellites would soon be affordable for a greater number of developing countries, businesses and universities with potential applications, for example, in efforts to improve agriculture and food security and access to medical services in rural areas.

13. Participants noted that the pace of technological change was faster than that of political decision-making and policy implementation. As the gap widened, serious and multiple questions, which society would have to answer, would continue to arise in matters concerning ethics, governance, equality and equity.

14. Frontier technologies such as artificial intelligence, for example, could eliminate some jobs while creating others. Although the net effect remained uncertain, there was evidence of the polarization of jobs and of the unfavourable impact on women in developed and developing countries. In lower-income countries that had large populations, in particular those facing a youth bulge, the lack of employment opportunities or the displacement of labour could aggravate poverty, leading to marginalization, disparities and conflict. Many developed countries had safety nets, such as unemployment benefits, which developing countries were unable to afford.

15. Participants pointed out that, for most developing countries, the net effects of frontier technologies on employment were likely to depend on the economic feasibility of introducing those technologies in the country's context; the structure of each country's economy; and the existing and potential prospects for trade

specialization. Participants stressed the need to counteract trends that contributed to increasing inequality within and between countries, further hampering the prospects of developing countries to catch up.

16. Participants mentioned that emerging technologies and technological convergence also gave rise to issues regarding the rights of citizens, privacy, data ownership and online security. Artificial intelligence systems and algorithms, for example, could reproduce biases such as gender and racial stereotypes or amplify the discriminations appearing in the data on which those systems were based.

17. Biotechnology combined with big data science produced vast amounts of data in the sequencing process. The data were curated in a decentralized way, and access in clinical medicine had been increasingly regulated, thus raising questions about data ownership. Another concern was the lack of diversity with respect to data sources. The majority of the participants in genome-wide association studies were of European ancestry.

18. Participants encouraged Governments to adopt institutional frameworks and regulatory regimes for data collection, use and access, and for data privacy and security, balancing individual and collective rights and allowing private sector innovation while taking into consideration the potential for the concentration of market power in digital technologies.

19. Participants also noted the need to solve the ethical and safety dilemmas of genetic manipulation and to have better mechanisms for identifying health hazards from emerging technologies, especially since most developing countries did not have the capacity to make comprehensive risk assessments. They also noted the importance of linking traditional knowledge with the new insights gained from modern science, thereby allowing for the owners of such knowledge to reap the benefits of that collaboration, as in the case of traditional medicine.

20. Participants noted that many countries had implemented strategies to harness science, technology and innovation, including to develop and adapt emerging technologies. Angola, for example, had supported economic diversification through science, technology and innovation; increased the number of researchers in science, technology, engineering and mathematics; developed science and technology parks; and established a national system for training methods in science, technology and innovation. Botswana had revised its policy on science, technology and innovation to turn the country into a knowledge-driven society instead of one driven by raw materials. Ghana had placed science, technology and innovation at the centre of its development agenda, under the theme "Ghana beyond aid"; initiated a review of national policy on science, technology and innovation; and established a national advisory council, a national research fund, an innovation and research commercialization centre, a national high-performance computing centre and the Ghana Radio Astronomy Observatory. Pakistan had a long-term vision and strategy for its socioeconomic development, "Vision 2025", and, through its science, technology and innovation policy for 2012, had recognized that investment in human resources and the development of science and technology infrastructure were critical to addressing rapid technological change. Poland had passed new ICT regulation to protect consumer interest, developed infrastructure and services, including fifth generation wireless systems, fostered competition in the ICT sector, promoted a paperless and eco-friendly society and business sector, and developed digital competencies for children and youth. Sri Lanka had engaged in promoting demand-driven research and innovation-focused industry-research links and in creating an enabling environment by supporting financially and technology-oriented entrepreneurship. The 2020 vision of Eswatini provided a road map to encourage the development of science, technology and innovation in the country. The national

strategy of Switzerland, known as "digital Switzerland", included the roll-out of broadband Internet service to reach excluded populations. Zambia had made significant policy changes in science, research and skills development, improving connectivity and promoting incubation centres and innovation hubs.

21. Participants highlighted that international collaboration played an essential role in improving human capacity in emerging technologies by facilitating collaborative research, technology transfer and the dissemination of knowledge on best practices in developing countries. In that regard, participants noted that China and UNCTAD were jointly implementing training workshops involving 40 participants from Commission member States on science, technology and innovation policy and incubator development in order to improve capabilities in science, technology and innovation for the achievement of the Goals. China had also reached out to accomplished young scientists from developing countries and junior professional officers to support the work of the Commission. Participants also noted that the United States of America had encouraged basic research and multi-stakeholder collaboration on science, technology and innovation in the context of the Goals.

22. Participants underscored the need for comprehensive assessment and foresight with regard to the effects of technological change in developed and developing countries. Such exercises should provide an evaluation of new and emerging technologies and identify potential setbacks and challenges while considering technological gaps within and between countries. Participants encouraged the Commission, as the focal point for science technology and innovation within the United Nations system, to conduct analyses and foresight activity with a view to assisting countries in seizing the opportunities afforded by technological change and in confronting the associated challenges.

23. Participants further noted that the Chair of the Commission would present the conclusions of the twenty-first session at the third session of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals, which would be held in New York on 5 and 6 June 2018.

Building digital competencies to benefit from existing and emerging technologies with a particular focus on gender and youth dimensions

24. Participants noted the mismatch between current education systems and the digital skills that might be required in many of the occupational categories in the coming decades. There was an increasing trend, especially within the population of emerging countries, and in particular among women and youth, to take up informal sector jobs. There was also a growing trend towards the gig economy, with high turnover rates and volatile aggregate pay.

25. Participants described how women and men were affected differently by technological change. Although there was a growing demand in the workforce for people with ICT skills, for example, in many countries women were still very much underrepresented in ICT specialist occupations. The representation of women and girls was also low in fields such as science, technology, engineering and mathematics. In upper secondary education globally only 10 per cent of women graduates held degrees in any of those fields, compared with 60 per cent of male graduates. Only 35 per cent of girls at the higher education level were in those fields, and fewer than 17 per cent of women held computer science degrees. Moreover, female employment in both developed and emerging economies was concentrated in low-growth occupations such as sales or clerical work.

26. One way of assessing the types of digital skills needed for the process of adoption, use, adaptation and creation of technologies was to look at them according to levels. Participants noted that the most fundamental skill sets for individuals and

companies in the digital era included the capability to adopt new technologies. In that context, "digital literacy for all" was an essential requirement for enabling every citizen to participate fully in the digital society. With regard to the creative use and adaptation of technologies, training in skills such as statistics, programming languages and big data analytics was necessary. The ability to redesign or modify technologies for creative use was noted as being essential for localizing emerging technologies in developing countries. Sophisticated programming skills and a knowledge of complex algorithms, such as machine learning, were necessary for innovation in the context of adapted technologies. Many advanced technologies were designed for use in contexts in which the infrastructure and natural and social resources differed from those in developing economies. In order to maximize the benefits of new technologies, it was therefore necessary for the labour force in developing countries and the companies therein to have the skills required to introduce modifications to such technologies. The creation of new technologies represented the final and the most advanced level of digital skills.

27. Participants shared their experiences with regard to incorporating digital competencies in the education system. They noted that education policies should emphasize the importance of digital competencies at all levels — in primary, secondary and higher education. Training should be available to both students and teachers. For example, Bolivia (Plurinational State of) had provided ICT training to more than 200,000 teachers between 2010 and 2015. Bulgaria had developed a strategy, "digital Bulgaria 2020", one of the objectives of which was to overcome the digital divide by enhancing digital literacy and stimulating the broad adoption and use of ICT by citizens, businesses and the public sector. Bulgaria stressed that training needed to be flexible since emerging technologies were continually changing, and the demand for digital skills increasing, which underscored the importance of lifelong training. In its recently introduced "digital Bulgaria 2025" programme, the Government had prioritized the advancement of digital competencies and skills and had envisaged the introduction of computer modelling as a new subject in primary school. Poland had implemented projects to develop skills and awareness among youth and the elderly, for example, a campaign ("Coding with UKE") that focused on supporting the development of digital competencies among youth through subjects such as coding with Scratch, smart city programming, robotics, and three-dimensional design. Other campaigns included "I know what I'm signing", which was directed especially at advising the elderly on how to conclude contracts, and "I click sensibly", which focused on teaching children how to "surf" online and use telecommunication devices safely, including ways to deal with online aggression and protect personal data. Participants noted that outside the formal education classroom setting, vocational training had the potential to help young people seize opportunities in the labour market. Turkey, through its "Industry 4.0" project, had set up vocational schools dedicated to providing young students with training in digital skills and familiarizing them with emerging technologies.

28. It was noted, however, that adapting to changing labour markets demands required more than digital skills alone. There was an increasing need to strengthen unique human skills that could not be easily replaced by machines, computers, algorithms and robots. In addition to digital competencies, building and strengthening complementary skills, such as complex problem identification and problem-solving, critical thinking and creativity, were essential to creating the flexibility required for current and future workforce demands. Ultimately, technologies comprised tools built and made available to solve problems. Competencies were needed to identify issues and to determine which tools were required, or even which technologies might need to be invented to address them.

29. Regarding the lower participation of women in ICT fields, participants noted that that was not the case in all parts of the world, nor was it the case historically. They noted several examples of women who had made significant contributions to the development of computer science and technologies early on, including Ada Lovelace, who programmed the Babbage Engine, and the women who programmed the Electronic Numerical Integrator and Computer (ENIAC). The causes for the current underrepresentation of women in the ICT field were complex, but examples of successful efforts to address some of them showed that it was possible to remove barriers. Participants noted that the main challenges to higher participation by women related to such issues as access, opportunity, availability of infrastructure and time. They also noted, however, some of the successful cases in tackling those challenges. Malta, for example, had launched a national digital strategy, which included actions to increase female participation in ICT sectors, and had raised awareness on digital skills education and careers to reduce the gender imbalance in the technology sectors.

30. Digital technologies and education could be mutually beneficial. Participants noted three innovations that could contribute to education: massive open online courses; open access to scientific literature and educational resources; and technology-mediated teaching and learning. Massive open online courses had the potential to deliver mass education at little or no cost. Open access to scientific literature and educational resources contributed to knowledge-sharing by facilitating access to literature and content. Latvia, for example, had developed a natural science and mathematics project that allowed for the production of support materials, which were available on the Internet, for teachers of biology, physics, mathematics and chemistry. In technology-mediated teaching and learning, artificial intelligence and big data analytics could help to assess the work of students and provide useful feedback. In addition, the Internet of things could be used to set up virtual classrooms utilizing the Internet, with the potential to transform remote learning into an interactive and engaging experience. Although those multimedia interfaces facilitated learning, they were meant to be complementary to the learning process since they worked best in conjunction with formal education and could not replace it.

31. Participants noted that an enabling environment included investments in digital infrastructure, policy and institutional development. Many countries had already implemented national strategies aimed at increasing digital competencies. The revised broadband policy and broadband strategy launched by South Africa, for example, aimed at ensuring universal access to ICTs by 2020. Some of the initiatives of the strategy included the establishment of a "digital doorway" for women in deep rural areas that would allow them to have access to ICT and obtain agricultural information. Other countries had focused their efforts on improving digital infrastructure and access. The "Connect home" initiative of the United States, for example, addressed the technology adoption issue by providing low-cost or free broadband access and digital literacy training to low-income families.

32. Nevertheless, today, more than half of the world's population was still offline, unable to benefit from the positive impact that ICTs could have on their lives. Participants emphasized the need to reach people living in remote regions; to reduce differences between communities in urban and rural areas; and to promote digital inclusion of the population in support of economic growth and poverty alleviation.

33. The skills mismatch should be addressed not only from the market-driven perspective of supply and demand but also from a sustainable viewpoint grounded in closing the gender and digital divides, respecting human rights and planetary boundaries, and overcoming structural barriers to access. Policies addressing skills mismatch should be constructed with due consideration given to differences between and within countries, demographics, and geography. A thorough understanding of the skills base of countries and industries, as well as evolving future skills requirements,

were necessary in order to accelerate progress in implementing the 2030 Agenda for Sustainable Development.

34. Member States were encouraged to implement policies aimed at establishing adequate ICT infrastructures, such as investing in facilities for data collection and infrastructure and data resources capabilities. They were also encouraged to incorporate training in digital competencies and soft skills in formal education and to promote the study of science, technology, engineering and mathematics, particularly among female students. They should also implement mechanisms such as foresight to identify trends in ICT development and skills needs that would help workers to meet current and emerging demands for competences, and support workers and enterprises adapt to change.

The role of science, technology and innovation in increasing the share of renewable energy substantially by 2030

35. Participants noted that 1.1 billion people did not have access to electricity, about 85 per cent of whom lived in rural areas, mainly in Africa. Over 10 million businesses were affected by lack of power. Moreover, 2.8 billion people did not have access to clean forms of energy for cooking. In many countries, the majority of people affected by energy poverty were women and girls.

36. Access to electricity and clean forms of energy for cooking played a critical role in achieving the 2030 Agenda, in particular Goal 7. Access to energy was needed not only for households but also for economic producers in such sectors as agriculture, industry and services, as well as for public and community spaces such as streets, schools and hospitals. Achieving Goal 7 was likely to have a significant positive impact on the achievement of other Goals, for example, by contributing to the development of modern infrastructure to reduce poverty and create income and opportunities (Goal 1); reducing health risks associated with pollution by the use of fossil fuels for cooking and lighting in homes (Goal 3); improving gender equality by reducing the time needed for women and girls to gather wood and allowing for more flexibility with regard to other activities (Goal 5); fostering innovation in renewable energy technologies (Goal 9); and mitigating greenhouse gases that cause climate change (Goal 13). Renewable energy and energy efficiency could contribute towards reducing energy-related carbon dioxide emissions by more than 90 per cent.

37. Participants noted some global trends in renewable energy deployment. The costs associated with the use of renewable energy technologies had fallen and were now comparable with, and in some projects cheaper than, those associated with the use fossil fuels. The contribution of renewable energy to the global primary energy demand, although still small at 14 per cent in 2016, had almost doubled in the past 25 years. Renewable energy now contributed to 23 per cent of electricity generation worldwide: 16 per cent from hydropower, 5 per cent from wind, geothermal, solar and tidal power, and 2 per cent from biomass and waste. Since 2012, over half of the total capacity added was in renewable energy technologies. Both renewable energy and energy efficiency were at the heart of the energy transition and climate goals. By 2050, action in both areas must be scaled up considerably.

38. Participants noted that, despite progress made at the global level, significant variations existed between countries. In countries of the European Union, the share of renewable energy was expected to double, rising to 34 per cent by 2030, to be cost-neutral and to create substantial economic and social benefits. Accelerating renewable deployment would be essential for Europe, in order to be in compliance with the Paris Agreement. Participants noted that in Poland the share of renewable energy in the energy mix accounted for 14 per cent, almost reaching the Europe 2020 target of 15 per cent for the country. China shared experiences in increasing the proportion of

renewable energy used, investing in new technologies, promoting renewable energy technology transfer and capacity-building, speeding up integration with new technologies such as artificial intelligence and blockchains and reducing poverty substantially. The Government considered renewable energy essential to achieving the Goals and to implementing the Paris Agreement. The Plurinational State of Bolivia had made renewable energy a priority and shared its vision to become a centre of energy production and an exporter of energy. Participants also noted the high potential for solar energy in Chile. Cuba had set ambitious targets related to renewable energy, engaging civil society and grass-roots groups, but financial assistance was required to support environmental education and the protection of vulnerable ecosystems.

39. Participants commented on the fact that, in the least developed countries, people relied to no small extent on traditional biomass for cooking and heating. Biomass generated 59 per cent of the total primary energy supply in those countries. Renewable energy, by contrast, comprised only 9 per cent of the total primary energy supplied. Such an energy mix caused severe and adverse personal and environmental consequences to those populations. It also hampered the capacity of least developed countries to engage in the structural transformation of their economies. The household sector accounted for two thirds of the energy consumption in those countries, reflecting the weak development of their productive capacities, which entailed a relatively low demand stemming from productive firms. In developed countries, by contrast, the household sector generated less than 20 per cent of energy consumption, with the bulk of demand arising from productive and community users.

40. Participants noted that the drivers and inhibitors of the development and deployment of renewable energy included cost and affordability, finance, technical maturity, appropriate skills, environmental sustainability and integration into electricity systems. Technological innovation could be accelerated both by international competition and cooperation, for example, through global innovation chains. There were benefits to encouraging each one of them in different circumstances. Governments played a role in funding research and development, creating demand through deployment incentives, reforming energy markets and setting standards, and strengthening investor confidence. A combination of affordable renewable technologies, digitalization and climate change policies was also driving change. In Poland, for example, the national fund for environmental protection and water management financed the green technology accelerator project (GreenEvo), through which small and medium-sized enterprises were encouraged to do business in the green economy sector, including renewable energy. The project had boosted the growth of renewable energy in the Polish private sector and the development of renewable energy technologies, in particular in biomass and biogas processing technologies, solar collectors, hydroelectric plants, geothermal power plants and offshore wind power plants.

41. With regard to the least developed countries, participants noted that the deficits in access to energy were rooted in the low electric supply capacity, which was only 2 per cent of that in developed countries. Across least developed countries, 42 per cent of enterprises identified electricity supply as a major constraint. Power outages cost companies in those countries an average of 7 per cent of the value of their sales.

42. There were significant opportunities for innovation to improve renewable technologies and reduce their costs, especially in the domain of solar cells, in the introduction of digital technologies into the energy systems and in the use of vehicles as energy storage devices. Opportunities for innovation also existed in coupling renewable technologies with technologies from other innovative sectors. In that regard, participants noted several examples of business-driven innovations in such areas as the auto industry, the shared economy, digital technologies and big data.

Technological progress and cost reductions in renewable energy could boost electrification, especially in rural areas in developing countries. Affordability was critical given that low-income communities might be unable to pay in advance for the investment required and investors might be equally unwilling to invest in uncertain returns owing to a low density of demand.

43. Productive use of electricity could also help to provide the demand needed for investments in electricity infrastructure to be viable. The increase in demand operated in two ways. First, the expansion of commercial and industrial firms created a demand for electricity, which was not only large-scale but also profitable, given the capacity of firms to pay for modern energy. Second, the expansion of productive activities, which led to structural transformation, generated additional employment and, therefore, additional demand for electricity. The additional demand helped to make the additional investment in the energy sector viable. The energy transformation nexus between energy use and structural transformation was central to sustainable development.

44. Participants highlighted that the integration of renewable energy into the grid infrastructure posed a technical challenge. Renewable energy was site-specific, and solar- or wind-rich areas could be distant from the demand and the grid infrastructure. There was therefore a need for innovation in infrastructure development, storage and technologies to increase demand-side flexibility. Participants discussed the possibility that off-grid, mini and pico grid renewable energy systems might prove to be faster than grid electrification in providing communities with access to electricity. Off-grid solutions, in particular solar photovoltaic technology, were likely to be the most cost-effective for universal electrification in sub-Saharan Africa. Nepal and Senegal were examples of least developed countries that had adopted such rural electrification programmes based on renewable energy.

45. Another challenge to the rapid and widespread adoption of renewable technologies was access to those technologies, in particular in the least developed countries. Participants noted that the international community had not yet developed an efficient mechanism of technology transfer to those countries.

46. The challenges disproportionally affected women. Women were often the primary managers of energy, but modern infrastructure reached women last. In sub-Saharan Africa, the Solar Sister initiative offered an example of a last-mile distributor that was led and driven by women and brought clean energy access to underserved communities. At Solar Sister, women were the agents of change and facilitated the last-mile distribution. Solar Sister sourced durable, affordable lights and stoves and managed the wholesale and retail aspects of the services provided. Communities benefited from solar lights and efficient stoves, which had a positive ripple effect on household finances, education and health.

47. Renewable energy pathways and related income-generation opportunities should have a central place in national development strategies because of their strategic importance. There was not just one optimal pathway for the deployment of renewable energy, and policymakers needed to balance aims and priorities, taking into consideration contextual factors such as geography, as well as cultural and institutional conditions. Policy mixes were necessary for supporting renewable energy deployment. They included complementary instruments such as feed-in tariffs, international standards, public procurement, mission innovation programmes and bottom-up funding mechanisms. Appropriate policy processes and governance mechanisms were needed to maximize their effectiveness.

48. Member States were encouraged to increase national support for research and development activities in renewable energy technologies and enabling technologies; adopt policy mixes that allowed for flexibility to support renewable energy innovation

and deployment; ensure the coherence of renewable energy policies with the national development agenda; enable the contribution of grid and off-grid solutions; support new business and financing models to ensure affordability; recognize and consider the social and cultural contexts of local communities; consider the gender impact of renewable energy deployment; promote North-South, South-South and triangular partnerships on renewable energy technologies; and build domestic innovative capacities, including skills for installing, maintaining and repairing renewable energy technologies.

49. The least developed countries must go beyond meeting basic household energy needs and target productive uses to achieve universal access to energy. The energy-transformation nexus was central to their development and achievement of Goal 7. They were encouraged to become early followers of new energy technologies, diversifying their power generation mix. The adoption of new energy technologies should be based not only on cost-effectiveness but should also reflect sustainability, inclusivity and structural transformation priorities. Least developed countries should also strengthen grid flexibility, upgrade monitoring and control capabilities, and adopt system-wide approaches to electricity markets, including energy efficiency practices and demand-side management.

50. ICTs had an essential role to play in increasing the share of renewable energy by 2030. The dissemination of accurate information about the benefits of renewable energy was yet another avenue that could ensure an increase in the substantial percentage of renewable energy use by 2030 and could be achieved through ICTs. There was therefore a need to involve the ICT sector in effectively and efficiently promoting renewable energy.

Partnerships and international cooperation

51. Participants called for partnerships in implementing national policies and programmes on science, technology and innovation. They also emphasized the importance of international and regional cooperation to promote shared experiences and lessons learned and to ensure that no one was left behind. Examples of relevant international cooperation mechanisms included the Belarusian-Pakistani Centre of Science and Technology Cooperation and the sub-centre (sub-centre Pakistan) established in Islamabad, as part of the China-South Asia Technology Transfer Centre, to assist research organizations, educational institutions and innovative industrial enterprises in expanding business and academic partnerships and contracts in the field of scientific and technological research.

52. Participants reiterated the critical importance of multi-stakeholder partnerships in building sustainable and resilient societies. They highlighted the need to strengthen the science, technology and innovation ecosystem, including to promote partnerships among donors dealing with the multifaceted resilience challenges facing the world. An example of such an endeavour was the partnership development complex created by the Islamic Development Bank to revitalize global partnerships. Collaboration among stakeholders could also contribute to building competencies in countries. Public-private partnerships, as well as partnerships between nations, could help to build digital skills and digital infrastructure. Uganda, for example, with the assistance of the Government of the Republic of Korea had built information access centres to facilitate e-government.

53. Participants stressed the importance of strengthening the close collaboration among international organizations to deliver coherent capacity-building programmes on science, technology and innovation in the context of implementing the Goals in developing countries. In that connection, they noted that the Inter-agency Task Team on Science, Technology and Innovation for the Sustainable Development Goals,

which was part of the Technology Facilitation Mechanism, had developed a United Nations system-wide training programme to assist Member States in enhancing their capacity to use science, technology and innovation for implementation of the Goals. The training was provided for the first time in Amman in April 2018 as a capacity-building workshop on innovation policies for the Goals in the Arab region. It was organized by the Economic and Social Commission for Western Asia and other members of the task team, namely, UNCTAD, the United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology, the United Nations Educational, Scientific and Cultural Organization, the United Nations Industrial Development Organization, the World Intellectual Property Organization and the Department of Economic and Social Affairs of the Secretariat, in cooperation with the Jordanian Higher Council for Science and Technology. Member States and the Task Team were encouraged to scale up the initiative to strengthen the capacities of developing countries in respect of science, technology and innovation and implementation of the Goals.

54. Participants also stressed the importance of fostering closer collaboration among international organizations to create initiatives aimed at building digital skills. For example, the "Digital skills for decent jobs campaign", an effort led by the International Telecommunication Union and the International Labour Organization to equip 5 million young women and men with job-ready digital skills by 2030 in support of the Goals, was part of a comprehensive United Nations system-wide effort to promote youth employment worldwide. A digital skills toolkit was designed to support the community involved in the Decent Jobs for Youth initiative and Member States in building their national digital skills strategies.

55. In that regard, it was crucial to tackle stereotypes regarding women participating in the fields of science, technology, engineering and mathematics and ICTs. Participants noted that the Commission on the Status of Women had urged Governments and others to address the persistent and widening gender divide concerning skills development and to improve the access of women to health care, productive lives, mobile learning and training in literacy. Participants also noted initiatives of the United Nations system, including EQUALS, the global network aimed at improving women's access to technology, building relevant digital skills and skills in the fields of science, technology, engineering and mathematics and promoting female leadership in the technology sector, thereby improving the lives of millions worldwide. In addition, International Girls in ICT Day, was celebrated every year on the fourth Thursday of April, and was aimed at creating a global environment that empowered and encouraged girls and young women to consider careers in the growing field of ICTs, enabling both girls and technology companies to reap the benefits of greater female participation in the ICT sector. To date, over 300,000 girls and young women had taken part in more than 9,000 celebrations of International Girls in ICT Day in 166 countries worldwide.

56. International and regional cooperation played a significant role in increasing the share of renewable energy in the global energy mix by 2030. International cooperation, including North-South and South-South cooperation, could comprise policy learning and capacity-building, technology development, improvements in the interconnection of grid infrastructures across borders, the expansion of manufacturing capacity or contributions through funding. It could bring together different players of a supply chain or help them to benefit from shared natural resources and infrastructure. Interregional cooperation was especially crucial in mitigating different renewable energy potentials owing to geographical differences between neighbouring countries.

57. Participants noted several examples of international cooperation with regard to renewable energy. Through the Solar Thermal Training and Demonstration Initiative

of South Africa, funded by the Austrian Development Agency and the Fund for International Development of the Organization of the Petroleum Exporting Countries, 187 small- to large-scale solar heating systems had been installed and 2,150 people in countries in the southern African region had been trained. A solar factory in Mozambique, representing a joint investment of the Governments of India and Mozambique, offered an example of technology and skills transfer between countries and employment creation in the manufacturing stage of the supply chain. Mission Innovation, a global initiative of 22 States and the European Union to accelerate global clean energy innovation, emphasized collaborative research, development and demonstration. The Global Alliance for Clean Cookstoves, a public-private partnership of more than 1,600 partners worldwide, played an instrumental role in supporting the research, design and roll-out of programmes for improved cookstoves. China provided technical assistance to Ghana and Zambia and supported capacity-building in collaboration with the United Nations Development Programme. China was also strengthening international cooperation within the Belt and Road Initiative. Chile was creating regional centres of excellence for research in collaboration with international research centres such as the Fraunhofer Institute in Germany.

58. Participants noted that in December 2018, Poland would host the twenty-fourth session of the Conference of Parties to the United Nations Framework Convention on Climate Change. The session would provide an opportunity for countries to work together on efforts to mitigate and adapt to climate change. Poland indicated that it would hold a series of side events focusing on issues critical to achieving a substantial hike in the share of renewable energy by 2030.

59. Member States were encouraged to continue to facilitate international and regional joint research activities on renewable energy; promote global collaboration on science, technology and innovation; and improve the interconnection across borders of grid infrastructure for renewable energy.

Commission on Science and Technology for Development

60. Participants reaffirmed the critical role of the Commission in promoting science, technology and innovation for development. They encouraged the Commission to continue to articulate the critical role of science, technology and innovation in the implementation of the Goals and to keep the General Assembly, the Economic and Social Council, the high-level political forum on sustainable development and other relevant forums apprised of developments in that regard. They also called on the Commission to serve as a forum for strategic planning and foresight regarding critical trends in science, technology and innovation in key sectors of the economy and to draw attention to emerging and disruptive technologies.

61. Participants encouraged the Commission to continue to collaborate with the Commission on the Status of Women on pursuing the common goal of a gender-responsive implementation of the 2030 Agenda. In that regard, participants encouraged the Commission to play a role in promoting a gender perspective in digital society, by considering how women and girls could benefit and contribute to science, technology and innovation, including by expanding their access to ICTs, supporting the increase of women's participation in jobs related to science, technology, engineering and mathematics, and promoting safe cyber use.

62. Participants encouraged the Commission to consider providing training programmes for policymakers on topics related to technological change, including on supporting countries to conduct foresight on ICT trends and capacity-building efforts to use and deploy technologies in developing countries, predominantly in the least developed countries. Participants noted that, as the secretariat of the Commission, UNCTAD was already working on those issues through its work on science,

technology and innovation policy reviews, and in the context of the Technology Bank for the Least Developed Countries, established pursuant to the Addis Ababa Action Agenda. UNCTAD was also working with the Government of China to provide short training programmes in China for academics from developing countries.

63. Participants encouraged the Commission to support multi-stakeholder collaboration in terms of policy learning, capacity-building and technology development in renewable energy; improving coordination among stakeholders and fostering partnerships in renewable energy that harnessed the specific expertise and interest of stakeholders; encouraging the sharing of lessons between countries and regions; and identifying mechanisms that improved capabilities in developing countries with regard to renewable energy, including skills to develop policies, flexible plans and regulations, and measures to strengthen capacities to absorb and maintain renewable energy technologies and adapt them to local contexts.